

## A Tribute to Deposition and Erosion

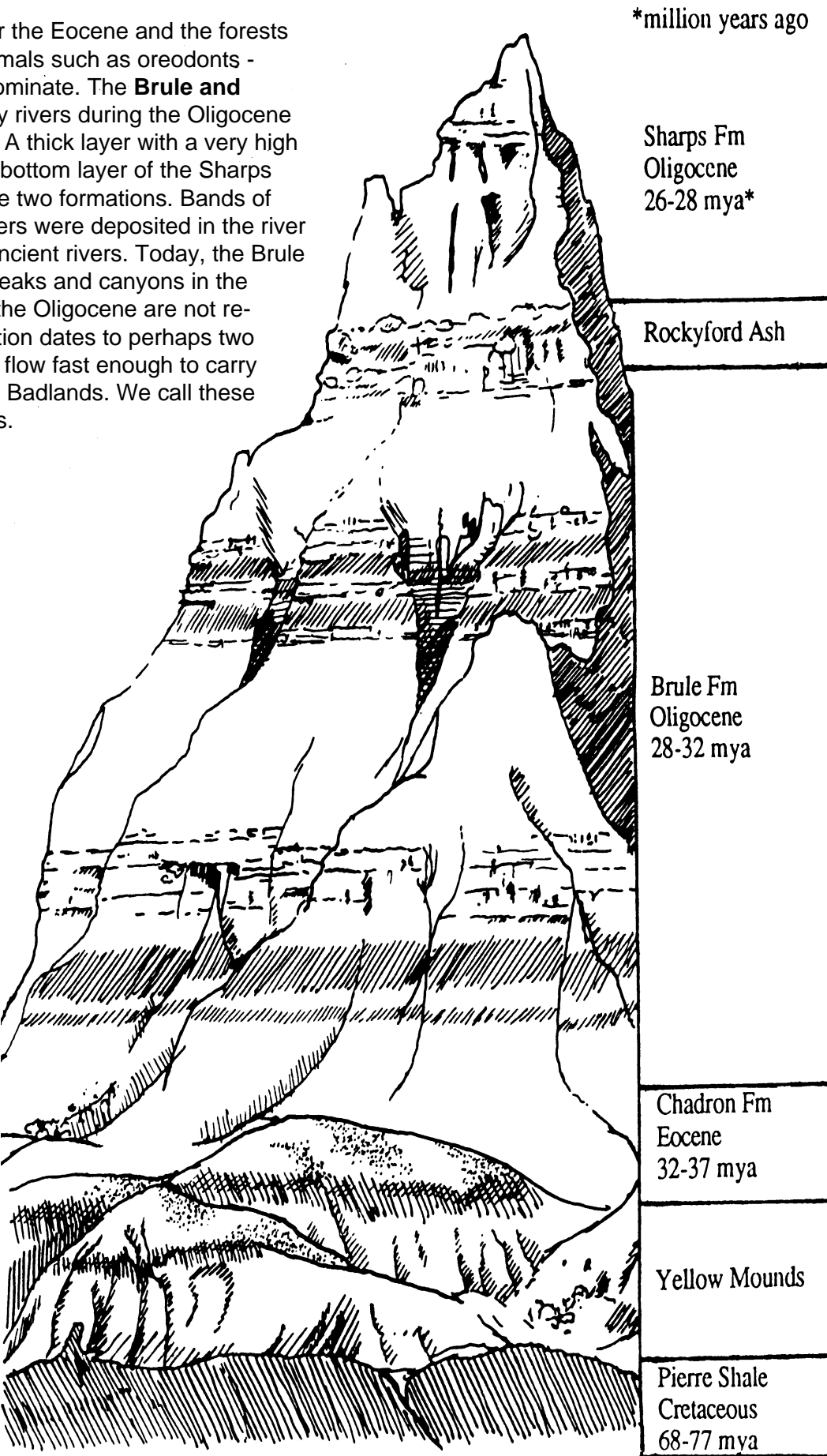
Deep canyons, towering spires, and flat-topped tables can all be found among Badlands buttes. Yet, despite their complex appearance, they are largely a result of two basic geologic processes: deposition and erosion.

A quick look at the buttes will show that the Badlands were deposited in layers. The layers are sedimentary rocks, composed of minute grains of rock materials that have been cemented into solid form. Geologists study sedimentary rocks to determine what type of environment caused the material to accumulate. Layers similar in character are grouped into units called formations.

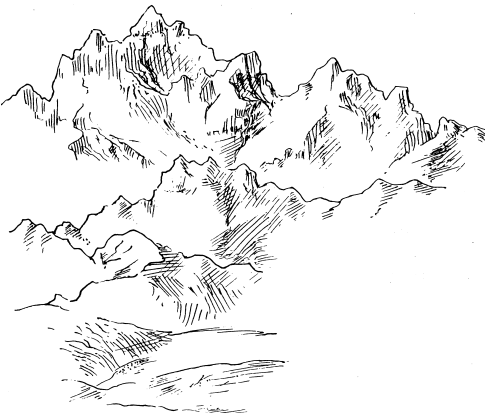
The climate began to dry and cool after the Eocene and the forests gave way to open savanna. New mammals such as oreodonts - sheep-like, her mammals - began to dominate. The **Brule and Sharps Formations** were deposited by rivers during the Oligocene Epoch from 26 to 32 million years ago. A thick layer with a very high ash content, the Rockyford Ash, is the bottom layer of the Sharps and serve as the boundary between the two formations. Bands of sandstone interspersed among the layers were deposited in the river channels and mark the course of the ancient rivers. Today, the Brule and Sharps contain the more rugged peaks and canyons in the Badlands. Periods of deposition after the Oligocene are not recorded in Badlands buttes. One exception dates to perhaps two million years ago when rivers began to flow fast enough to carry cobbles of hard Black Hills rocks to the Badlands. We call these cobble beds the Medicine Root Gravels.

The **Chadron Formation** was deposited between 32 and 37 million years ago as a riverine flood plain that replaced the sea. Each time the rivers flooded, they deposited a new layer on the plain. Alligator fossils indicate that a lush, subtropical forest covered the land. However, mammal fossils dominate. The Chadron is known for large, rhinoceros-like mammals called titanotheres. The formation can be recognized because it erodes into low, regular mounds.

The bottom formation is the **Pierre Shale**, deposited between 68 and 77 million years ago during the Cretaceous Period when a shallow, inland sea stretched across what is now the Great Plains. Sediment filtered through the sea water, forming a black mud on the sea floor that has since hardened into shale. Fossil clam shells and ammonites confirm the sea environment. The sea drained away with the uplift of the Black Hills and Rocky Mountains, exposing the black shale to the air. Upper layers were weathered into a soil, now seen as the **yellow mounds**. The mounds are an example of a fossil soil, or paleosol.



## Wind and Water Erosion: It Takes Teamwork



The serrated Badlands terrain did not exist until about 500,000 years ago when water began to cut down through the rock layers, carving fantastic shapes into what had been a flat flood-plain. The ancient fossil soils, buried for millions of years, became exposed once again. The layers are flat, not warped or tilted, which reminds us that mountain building never occurred.

Erosion is ongoing. Every time it rains, more sediments are washed from the buttes. While the Badlands are long lasting in human terms, they are short lived in terms of geologic time. Evidence suggests that they will erode completely away in another 500,000 years, giving them a life of one million years. Compare that to the age of the earth, which is 4.6 billion years old. Even the Rocky Mountains, considered young, started to rise 70 million years ago. On average, Badlands buttes erode one inch each year. But change can occur much slower or faster. One day, a peak may tower above the land; the next, a storm may weaken it just enough for it to crash to the ground.

When buttes erode, some sediments are washed onto the prairie below, building up its level. Others are carried to the White, Bad, and Cheyenne Rivers. These flow into the Missouri which drains into the Mississippi. Some Badlands sediments eventually travel as far as the Gulf of Mexico.

## The Badlands Wall

The Loop Road hugs the Badlands wall, a long, narrow spine of buttes that stretches 60 miles from Kadoka west towards Scenic. The wall parallels the White River and formed when the river started to cut through Badlands sediments. As erosion has continued, the wall has retreated north from the river. The town of Wall, South Dakota takes its name from this feature that dominates the horizon.

## Sod Tables



Sediments washed from the buttes onto the prairie have been secondarily carved by water into low sod tables, characterized by grassy tops and vertical sides. A close inspection will reveal records of recent events: charcoal lines from prairie fires, camp hearths left by people who have lived here for the past 12,000 years, and bleached bones of bison and other modern animals.

## Slumps

Oases of plant and animal life can develop on otherwise barren buttes thanks to catastrophic geologic events. A slump forms when a huge chunk of Badlands slips down the side of a butte as one unit. Rock becomes compacted, so water drains slowly and remains available for plants and animals. Cliff Shelf is an example of a slump.

## Caprocks and Hoodoos



Harder rocks, such as sandstone, resist erosion and shelter the softer claystone beneath them, earning the name “caprocks.” Sometimes the surrounding claystone erodes, leaving the caprock sitting on a column of softer rock. This features. Is know as a “hoodoo.”

## Armored Mud Balls



A walk down a dry wash might yield a fun discovery - a perfectly round ball of mud with a pebble coating. It may be the size of a marble or a basketball. Armored mud balls form when rain causes the washes to flow. Mud carried by the flowing water picks up additional mud as it rolls.

## Clastic Dikes

Thin, vertical stripes that run nearly perpendicular to the horizontal layers are called clastic dikes. Cracks developed in the buttes and were filled in by sediments. Pressure has compressed the sediments, making them harder than the surrounding rocks. However, the cause of the cracking is unknown. Some geologists argue that intense drying created the deep cracks. Other feels that they resulted from shifting and settling of the layers.

## It's Ancient History

Many people believe that geology is all in the past. The truth is geology is surrounding you everyday and is happening even as you read. It is a science that is as important to the future as it is to the past. Geology helps us select where to build our homes and communities. It is the foundation for many other sciences, as well as a partner with biology in the science of paleontology, the study of ancient life. The geologic formations found in Badlands National Park may change during your visit!